The economics of trade protection

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CHAPTER 1

Basic international trade theory

This introductory chapter develops basic analytical tools that are commonly used in trade and protection theory. It will also serve as a compendium of some of the better known results in the field, which will be useful for reference in later chapters. Much of this material is familiar to students who have completed a course in the pure theory of international trade; such students may find a cursory reading of the chapter to be adequate.

The main model to be considered here was originally formulated by Swedish economists E. Heckscher and B. Ohlin, with a view to explaining the pattern of trade between countries. It is perhaps ironic that, although the model has had limited success in explaining the determinants of trade, subsequent developments (most notably by Paul Samuelson) have made it a popular general equilibrium framework for analysis of impediments to trade in competitive markets. On the other hand, it is less easily adapted to analysing situations in which markets are not perfectly competitive and in which production may exhibit economies of scale. In such cases (which we consider in Chapters 5–7), it is often more expeditious to employ a partial equilibrium framework. Nevertheless, the two-sector model presented in this chapter serves as a useful reference point for our analysis.

Our approach to presenting the basic model is necessarily heuristic, using diagrams and verbal intuition wherever possible. More advanced students may want a more rigorous treatment. For these students, Appendix 1 contains a full mathematical specification of the model together with proofs of the main results obtained in this chapter.

1.1. The Heckscher–Ohlin–Samuelson model

The main features of this model for a single country are as follows. The economy is assumed to produce two goods, food and cloth, using two factors of production, capital and labour, which are perfectly mobile between sectors. This factor-mobility assumption is central to the Heckscher–Ohlin–Samuelson (HOS) model, distinguishing it from the Ricardo–Viner specific-factors model, which we consider in Section 1.4. Production functions for both goods are assumed to exhibit constant returns to scale, with diminishing returns to each factor. All markets are perfectly competitive, and it is assumed that the economy's balance of payments is zero (i.e. income = expenditure). We shall begin by considering the consumption side of the model.

(a) Consumers

The appropriate starting point for consideration of the demand side of the economy is the preferences of individual consumers. Figure 1.1 illustrates a set of indifference curves for a typical individual in the economy. As is well known to any undergraduate microeconomics student, all points along a given indifference curve (say u_1) yield the consumer the same level of welfare. Moreover, it is customary to assume that these curves are strictly convex to the origin, downward sloping, and that higher curves correspond to higher levels of utility. The underlying utility function is generally assumed to be *ordinal* (i.e. it is defined up to a strictly increasing monotonic transformation). A consumer maximizes her utility, subject to a budget constraint (line *AB* in Figure 1.1), the result being an equilibrium for the consumer at the tangency point *E*.

In moving from the individual to the community as a whole, we encounter the problem of defining and establishing the existence of a set of *community-indifference curves,* which (one might hope) have the same properties (e.g. convexity) as those for the individual consumer. Unfortunately, the mere existence of a set of well-defined community-indifference curves depends on a set of very restrictive assumptions. For example, if each individual's consumption of each good is constrained to be non-negative, and if there are no restrictions on prices and the distribution of incomes among consumers, then a necessary and sufficient condition for the existence of an aggregate utility function is that all consumers have *identical homothetic preferences.*[1] At the same time, much expositional simplicity is gained by using community-indifference curves. With this in mind, we shall assume throughout the book that (i) society can maximize its welfare as if it were a single individual with a well-behaved convex indifference map, and (ii) a higher level of community welfare can be translated into higher welfare for each individual in the community by means of appropriate lump-sum transfers between individuals. We should, however, be careful not to lose sight of the strong assumptions underpinning this approach.

(b) Production

Figure 1.2 illustrates the economy's production possibilities frontier (or production-transformation curve). This frontier (curve *AB* in the diagram) shows the maximum output of each good which can be produced with the economy's existing factor supplies for any given output of the other good. Clearly, such things as factor growth and technical change can make it possible to produce more of either good, thus shifting the curve outwards. Similarly, wasteful or non-productive use of resources shift it in and to the left.

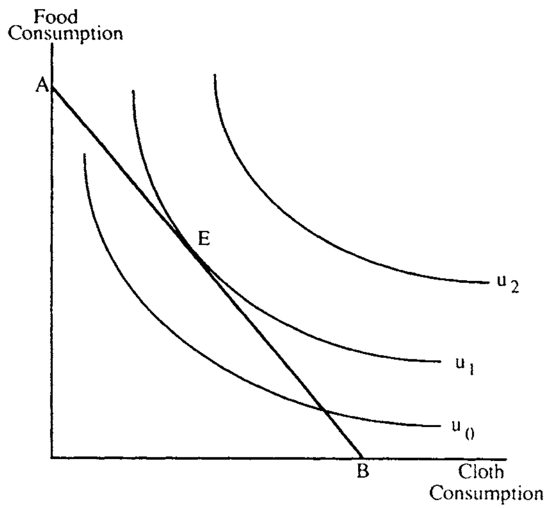

Figure 1.1

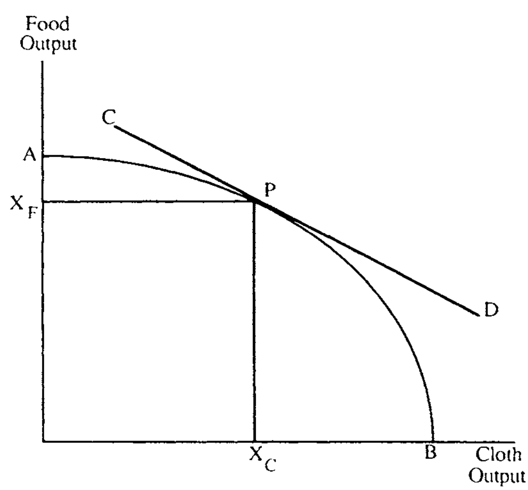

Figure 1.2

The bowed-out or concave form of the curve reflects the particular assumptions of the supply side of the model: that is, competitive good and factor markets, constant-returns-to-scale technology, with diminishing returns to each factor, and the additional assumption that the factor intensities (the ratio of capital input to labour input) are different in the two sectors. Here we assume without loss of generality that food production employs a higher ratio of capital to labour than cloth, at all relevant output levels (i.e. food is relatively capital intensive). Then as, say, the capital-intensive sector (food) expands and the labour-intensive sector (cloth) contracts, declining cloth output releases relatively more labour and relatively less capital than the expanding food sector requires; this leads to an excess demand for capital and an excess supply of labour, which drives the wage–rental ratio down and thus reduces the unit cost of cloth (which uses labour more intensively) and increases the unit cost of food. That is, as food output increases, the opportunity cost of an additional unit of food rises. This explains why the production frontier has the concave form illustrated in Figure 1.2.[2]

Figure 1.2 also illustrates the determination of the economy's equilibrium output levels for the two goods. The slope of line *CD* represents the relative price of cloth faced by producers. Under the assumption of competitive markets, production occurs at point *P*, where the price line *CD* is tangent to the production frontier. Output of food and cloth are X_F and X_C, respectively. This tangency reflects the fact that, in competitive equilibrium, the relative price of cloth and the marginal rate of transformation of food into cloth are equal. The equilibrium production point has the property that, at the existing relative prices, the total value of national output cannot be increased by any feasible change in sectoral outputs. The prices associated with the price line *CD* are sometimes said to *support* production at point *P*.

(c) Autarky and free-trade equilibrium

Having seen how consumers and producers optimize subject to a given price, we now consider the equilibrium which results from the interaction of the two groups. In a situation of autarky in which the economy does not trade with the rest of the world, equilibrium prices are those at which consumer demand equals producer supply for each good (we assume that these equilibrium prices exist and are unique). The equilibrium price ratio for the two-good economy is given by the slope of the price line p_A, which is tangential to both the production frontier and the community indifference curve u_A at point *A* in Figure 1.3a. This separating price line supports equilibrium consumption (and production) of food C_F ($=X_F$) and of cloth C_C ($=X_C$).

Now suppose that the economy is opened to trade with the rest of the world. The equilibrium price no longer is determined so as to clear markets in the domestic economy (unless that economy is such a large part of the world economy for the problem to be uninteresting). Instead, relative prices adjust to equate world supply and demand for each good; indeed, if the country we are considering is small in the world market, its demands and supplies do not affect the world price at all. Figure 1.3b shows both the autarkic equilibrium *A* and the free-trade equilibrium for the country in question. Price line p^* represents the market-clearing world price ratio. We shall not concern ourselves here with

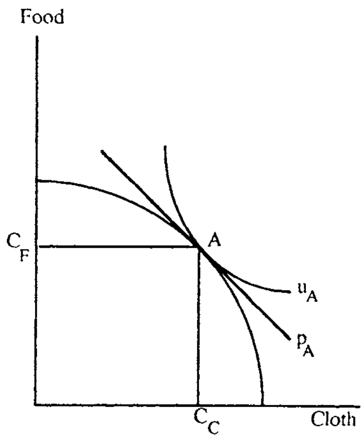

Figure 1.3a

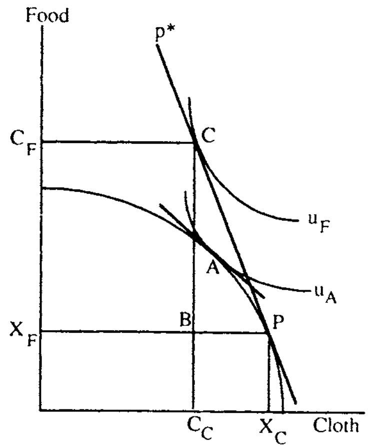

Figure 1.3b

how world prices are determined, leaving the details of that problem until Section 1.5. To make our point, it is sufficient that free-trade relative prices p^* differ from the country's autarkic relative prices p_A. Faced with relative prices p^*, we know that producers will produce where p^* is tangential to the economy's production frontier, at point P in Figure 1.3b. It remains for us to identify the economy's consumption point. To do this, we must make use of another assumption of the model: the economy's income equals its expenditure. This is the same as assuming that the economy always balances its trade. Of course, we know that this does not happen in reality, but it is both a natural and a relatively harmless assumption in the present context. It is justified here because our central concern is the effects of trade (and protection) on the *real* economy. A non-zero trade balance would imply that the economy's stock of wealth is changing over time via monetary inflows and outflows, international capital flows and so on; we want to abstract from such transitory wealth effects and focus on long-run equilibrium, where wealth levels have adjusted to restore a zero trade balance.

Accordingly, the economy's consumption must equal the value of its output (P) at world prices p^*; that is, the free-trade consumption point must lie on the world price line p^* through P. Given that p^* is effectively the budget line facing consumers, the economy's consumption point is at point C in Figure 1.3b, where a community indifference curve is tangential to p^*. Given the absence of any domestic distortions such as tariffs, taxes and subsidies, this equilibrium involves equality between relative prices, the marginal rate of substitution in consumption and the marginal rate of transformation in production. The economy produces X_C and X_F units of cloth and food, and consumes C_C and C_F. It exports its excess supply of cloth ($X_C - C_C$) in return for imports equal to its excess demand for food ($C_F - X_F$). These exports and imports are also given by the sides of the triangle *CBP*, which is often referred to as the "trade triangle." In this case, *CB* measures imports and *BP* measures exports.

The level of community utility associated with the free-trade equilibrium is u_F, which is seen to be higher than the level of utility u_A under autarky; that is, the economy has gained from trade.[3] Of course, we are referring here to an aggregate gain (see the preceding discussion of community indifference curves). Concealed behind the move from community indifference curve u_A to curve u_F are the gains and losses of different agents in the economy. In particular, domestic sellers of the importable and buyers of the exportable are made worse off by the change in relative prices associated with the move to free trade (just as domestic buyers of the importable and sellers of the exportable are made better off). However, for the move from u_A to u_F to be interpreted as a strict Pareto improvement for the economy (no individual worse off and at least one individual better off), it would have to be accompanied by an appropriate set of redistributions between agents, such that the losers are compensated by the gainers and in the final equilibrium no one is made worse off. Moreover, insofar as there are no commodity taxes or subsidies in the model of Figure 1.3, it is implicitly assumed that the necessary redistributions are effected by means of lump-sum transfers. Unfortunately, the use of such lump-sum compensation is fraught with difficulties, primarily because the appropriate transfer is different for each individual, giving each individual an opportunity and an incentive to mislead the tax authorities by overstating her loss or understating her gain from a particular policy. Accordingly, interest has recently shifted to the question of whether the potential Pareto improvement associated with trade liberalization can be achieved by employing a set of commodity taxes and subsidies which are the same for all individuals and are thus relatively immune to the preceding problem. At this stage, it would appear that under certain conditions an appropriate set of taxes and subsidies *can* be found (see Dixit and Norman, 1980, 1986; Kemp and Wan, 1986). Nevertheless, the issue of how the gains from trade are distributed in the absence of lump-sum compensation remains a promising area for future research.

Let us now abstract from the problem of how the gains from trade are distributed and consider the aggregate gain (the increase in community utility from u_A to u_F in Figure 1.3b). What is the source of this gain? It has come about because the economy is no longer constrained to consume exactly what it produces of each good; it can now be a net seller (exporter) of one good and a net buyer (importer) of the other good, with its opportunity set enlarged from the area enclosed by the production frontier and the axes to the area enclosed by the world price line p^* and the axes (i.e. the economy can now transform one good into another by international trade as well as by production). Only if the

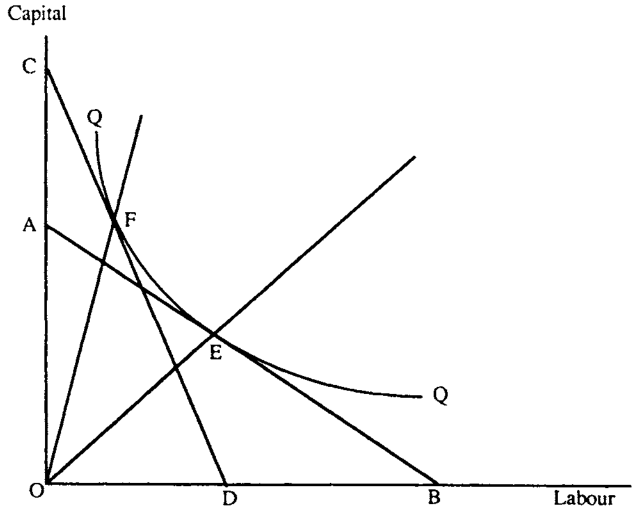

Figure 1.4

world price ratio just happens to equal the economy's equilibrium autarky price ratio, will the economy be no better off from trade. In such a case, its opportunity set is still larger than under autarky, but its chosen consumption point in that set is the autarky equilibrium A.

This completes our specification of trading equilibrium for a single country. In Section 1.5 we shall consider how equilibrium is determined in a world consisting of two such countries, and in subsequent chapters we shall also consider how a trading equilibrium is affected by various distortions such as tariffs and import quotas. However, before proceeding to other questions, it is worth pausing to derive some important results which flow from the production structure of the HOS model.

1.2. Factor intensities, factor prices and product prices

We now consider the relationships between product prices, factor prices and factor intensities in the HOS model. These relationships (which are subsumed in the production equilibrium already derived) constitute some of the better known "theorems" of pure trade theory.

We begin by noting that, for a constant-returns-to-scale production function, a rise in the relative price of a factor causes that factor to be used less intensively in both sectors. This is readily seen with the aid of Figure 1.4, which illustrates the choice of input mix for either of the goods produced in the economy. Suppose one unit of the good is being produced. The isoquant for this output

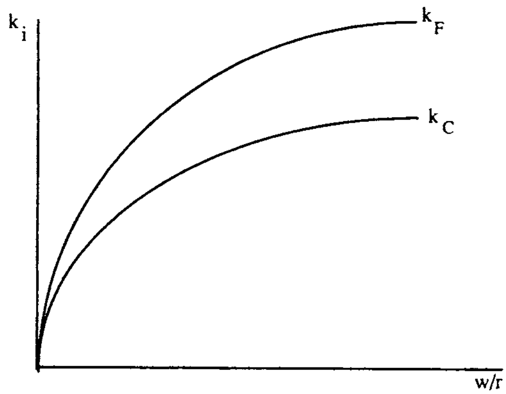

Figure 1.5

(the unit isoquant) is represented by the convex curve QQ in Figure 1.4. This shows the different combinations of capital and labour which produce one unit of the good. The least-cost combination of these factors is where the ratio of the factor prices (the slope of an isocost line) equals the marginal rate of substitution of one factor for another (the slope of the isoquant) – that is, a point of tangency between the unit isoquant and an isocost line. Point E is one such tangency when the ratio of the price of labour to the price of capital (the wage–rental ratio, w/r) is given by the slope of isocost line AB. The cost-minimizing ratio of capital to labour is given by the slope of the ray OE. Now, suppose that the wage–rental ratio increases. This implies steeper isocost lines, with one such line (CD) touching the isoquant at the cost-minimizing point F. Clearly the ray OF is steeper than OE, implying an increase in the capital–labour ratio. Finally, we note that, for constant returns to scale production functions, a given factor price ratio implies the same factor input ratio at all scales of output, so the result (just proven for the case of unit output) is true at all levels of output. Figure 1.5 illustrates this relationship between the capital–labour ratio in each sector (k_i for sector i) and the economy's wage–rental ratio (w/r).

Let us now consider how changes in the economy's product price ratio affect factor prices. The way in which changes in product prices feed through to factor rewards is of particular relevance when we are considering the income-distribution implications of protection. Tariffs, production subsidies and so on all change the producer price of the protected good, and it is of interest to see how a particular factor gains or loses as a result. Such information may be of help in explaining the pro- and anti-protectionist positions that different groups adopt.

For simplicity, we shall confine our attention to the case in which both goods are produced in equilibrium. Given that both sectors are perfectly competitive, equilibrium entails zero profits in both sectors. It is these zero-profit conditions

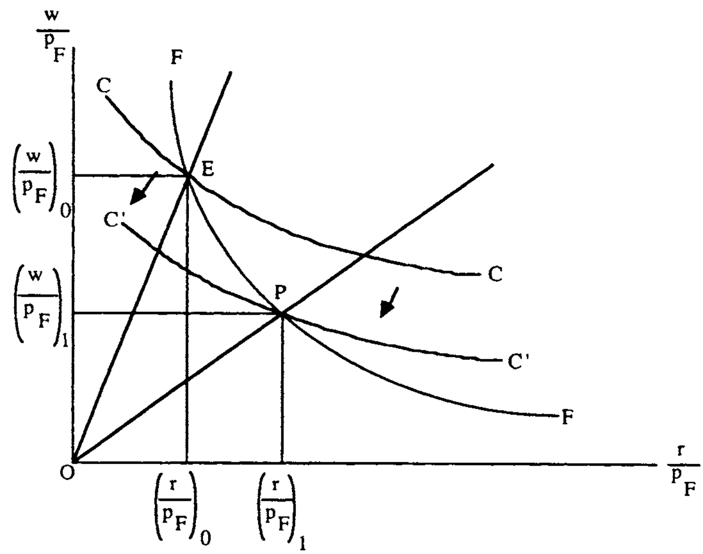

Figure 1.6

which determine the relationship between product and factor prices. A rise in the relative price of food due to, say, a tariff on food creates positive profits in the food sector. This attracts new firms into the sector, which, you will recall, is more capital-intensive than the cloth sector ($k_F > k_C$). As food production expands and cloth production contracts, relatively more capital is demanded by the food sector than is being released by the cloth sector (equivalently, the cloth sector is releasing relatively more labour than the food sector wants to take up). This implies an excess demand for capital and an excess supply of labour. To clear the factor markets, the real return to capital must rise, and the real return to labour must fall. In other words, a rise in the relative price of food leads to an increase in the real return to the factor used intensively in food production. This result may be stated more generally as:

The Stolper–Samuelson theorem: A rise in the relative price of a commodity leads to a rise in the real return to the factor used intensively in producing that commodity and to a fall in the real return to the other factor.

Figure 1.6 offers a fairly simple diagrammatic proof of the Stolper–Samuelson theorem (an algebraic proof can be found in Appendix 1). Loci *FF* and *CC* in Figure 1.6 represent the combinations of real factor rewards (expressed in food units) that yield zero real profits per unit (also measured in food units) in the food and cloth sectors, respectively. In this figure, w is the nominal wage, r is the nominal return to a unit of capital and p_F is the price of a unit of food; so w/p_F and r/p_F are the real factor returns measured in units of food. Both loci are downward sloping because, at given relative product prices, a higher price of one factor yields negative profits in either sector unless it is offset by a lower price of the other factor. Furthermore, the higher the capital–labour ratio in a sector, the greater is the fall in profits caused by a rise in the price of capital, and hence the larger is the fall in the price of labour needed to restore profits to zero in that sector. In other words, a sector's iso-profit curve is steeper the higher its capital–labour ratio.[4] This has two implications for the curves in Figure 1.6. First, it means that at any given wage–rental ratio, the zero-profit locus of the more capital-intensive sector (*FF*) must have a steeper absolute slope than that of the other sector (*CC*). Second, it implies that the loci are convex to the origin. This is because as we move to the right along either locus, the wage–rental ratio (w/r) is falling, leading to a fall in the capital–labour ratio of both sectors (as illustrated in Figure 1.5). Moreover, as a sector becomes less capital intensive, its zero-profit locus becomes flatter; it thus follows that the two loci are convex to the origin as shown. Given that both goods are produced, profits are zero in both sectors, and the equilibrium is at the point of intersection of *FF* and *CC* (*E* in Figure 1.6).

Now suppose there is a rise in the relative price of food. This does not affect real food profits measured in food units, so the *FF* locus does not shift. However, the real price of a unit of cloth has fallen, so real cloth profits will be negative unless the real return to either factor falls; thus the *CC* locus shifts down and to the left to position *C′C′*. The new equilibrium is at point *P* where *C′C′* intersects *FF*. In the move to the new equilibrium, the real wage has fallen from $(w/p_F)_0$ to $(w/p_F)_1$ while the real return to capital has risen from $(r/p_F)_0$ to $(r/p_F)_1$. The wage–rental ratio, which is given by the slope of the ray joining the equilibrium point to the origin, also clearly falls. Given that capital's return has increased relative to the food price, it must also have increased relative to the price of cloth. If we had made cloth the numeraire instead of food in Figure 1.6, we would have seen that the wage measured in cloth units also falls (the reader may like to check this as an exercise). Thus, the real return to capital unambiguously rises and the real return to labour unambiguously falls in terms of both goods: regardless of how each factor allocates its spending between food and cloth, capital is clearly better off and labour is worse off as a result of the rise in the relative price of food.

One possible implication of the Stolper–Samuelson theorem is that the imposition of a tariff (which raises the domestic relative price of the importable good) benefits the factor used intensively in the importables sector and hurts the other factor.[5] However, such a conclusion would, in turn, imply that labour and capital would be expected to take opposite sides in lobbying for and against protection, something which is rarely observed (if at all). This has led a number of economists to question the HOS model's underlying assumption of perfect inter-sectoral factor mobility. An alternative model, which seems better suited to explaining the income distributional effects of tariffs and subsidies (and the observed responses of pressure groups), assumes that production in each sector combines a single mobile factor (labour) with industry-specific factors which are immobile between sectors. This model (the Ricardo–Viner–Jones specific factors model) is considered in detail in Section 1.4 and appears to offer a more satisfactory explanation of observed events. Nevertheless the Stolper–Samuelson result may have some value as a description of the longer run when factors are relatively mobile between sectors.

Before we proceed, it is worth noting another implication of Figure 1.6: that the economy's relative product prices uniquely determine factor prices. Given that free international trade in commodities will equate relative commodity prices across countries, it is clear from the preceding discussion that factor prices will also be equalized across countries that have the same technology, even though the factors in question are not mobile internationally. This observation is the substance of another well-known result of trade theory, the *factor–price equalization theorem* (for a rigorous proof of this theorem and a critical discussion of its interpretation see Dixit and Norman, 1980).

1.3. Factor endowments and the Rybczynski theorem

During the 1950s, trade theorists became interested in the effects of factor growth on the structure of industry. In particular, they wished to know how changes in an economy's relative factor supplies would affect sectoral outputs at any given commodity price ratio. We know from the previous section that, at fixed relative product prices, factor prices and input ratios are also fixed. Thus, factor substitution, while still a technical possibility, can be ignored in this case. The effects of factor growth may then be illustrated using Figure 1.7. Lines *KK* and *LL* represent the combinations of outputs of cloth and food which yield full employment of given endowments of capital and labour, respectively.[6] Each is negatively sloped because, for given factor endowments, higher output and factor demand in one sector must be offset by lower factor demand and lower output in the other sector. Both curves have constant slope[7] because input–output ratios in both sectors are fixed by product prices; thus, the amount by which output of one sector must contract in order to release enough of a particular factor to produce an extra unit of the other good is independent of output levels. In addition, the *KK* line is flatter than the *LL* line.[8] This is because a given rise in cloth output reduces food output less via the economy's capital constraint *KK* than via its labour constraint *LL* (because cloth requires relatively less capital).

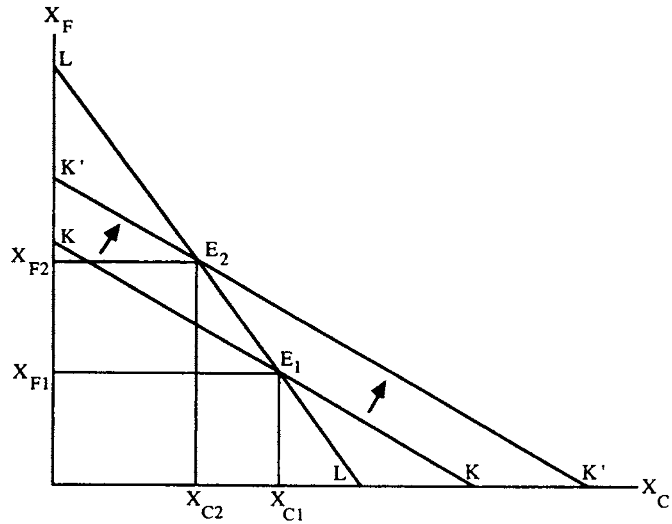

Figure 1.7

Initial equilibrium occurs where both factors are fully employed, at the intersection of *LL* and *KK* at point E_1 in Figure 1.7. Now suppose the economy's endowment of capital increases. This leaves *LL* unaffected but shifts *KK* out and to the right to position *K'K'* (because more of either output can now be produced at a given level of the other output without exceeding the economy's supply of capital). The equilibrium shifts to E_2, where *K'K'* cuts *LL*. Food output rises from X_{F1} to X_{F2} while cloth output contracts from X_{C1} to X_{C2}. This result can be more generally stated as:

Rybczynski's theorem: If an economy's endowment of one factor increases while the other factor is in fixed supply, the output of the good using the augmented factor intensively will increase while the output of the other good will contract.

It is straightforward to extend the Rybczynski result to cases in which endowments of both factors are changing. In particular, it can be shown (see Appendix 1) that:

A rise in the endowment of one factor relative to the other will increase the output of the good using that factor intensively relative to output of the other good.

The reader can check this result using Figure 1.7. An increase in the endowments of both capital and labour shift both *KK* and *LL* out and to the right. If both factors increase in the same proportion, the two lines shift by the same proportion, with the new equilibrium lying along the same ray through the origin as the original equilibrium. In such a case, the relative outputs of the two sectors are unchanged by the factor growth. On the other hand, if, say, the endowment of capital increases proportionately more than the endowment of labour, *KK* will shift out by a greater proportion than *LL*, and equilibrium will move onto a steeper ray through the origin, implying an increase in the relative output of the capital-intensive good (food).

Results of the Rybczynski type are of particular interest in situations where resources are being withdrawn from productive use (negative factor growth), as might be the case for certain government projects, rent-seeking activity and so on. In such cases, the results of this section need only be applied in reverse. We shall consider such an application when we analyse rent seeking in Chapter 3.

1.4. Specific factors and income distribution in the short run

We now consider an alternative to the HOS framework, the so-called Ricardo–Viner specific factors model as developed by Jones (1971a, 1975), Mayer (1974) and Mussa (1974). As we observed in Section 1.2, the HOS model's assumption of perfect mobility of factors between sectors leads to results such as the Stolper–Samuelson theorem, which appear to be at odds with observed behaviour. In particular, the Stolper–Samuelson theorem implies that any tariff is unequivocally supported by one factor (the factor used intensively in the industry protected by the tariff) and opposed by the other factor (whose real return is reduced by the tariff). However, such a conflict of interest between factors in an industry sits uneasily with the frequently observed pro-protection coalitions of capital and labour within industries (see Magee, 1978, for empirical evidence). As we shall see in this section, such instances of commonality of interest within an industry can be explained by the immobility (or specificity) of certain factors in the short run. We shall now examine the effects of introducing specific factors into the basic two-sector model. Apart from the different approach to factor mobility, the model is formally identical to the HOS model outlined in Section 1.1.

The model assumes that one factor (labour) is perfectly mobile between sectors. Each sector's output is produced by combining this mobile factor with its own sector-specific factor (capital), which, by definition, is immobile between sectors. Thus, food is produced using labour L_F and food-specific capital K_F, whereas cloth is produced using labour L_C and cloth-specific capital K_C. Because labour is freely mobile between sectors, the economy's total labour supply L is allocated so that the value of the marginal product of labour in each sector is equated to the money wage w. The nominal rental rate for food capital is denoted by r_F, and the rate for cloth capital is r_C. Because each type of capital

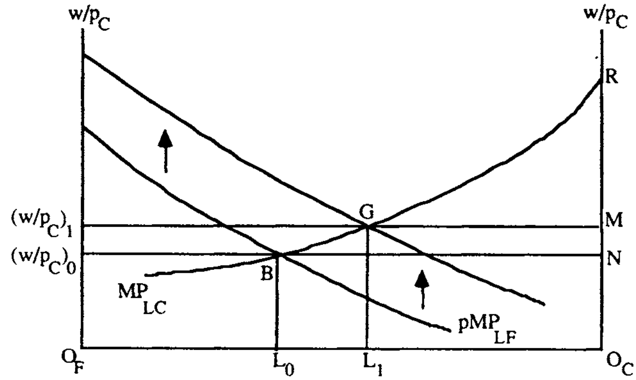

Figure 1.8a

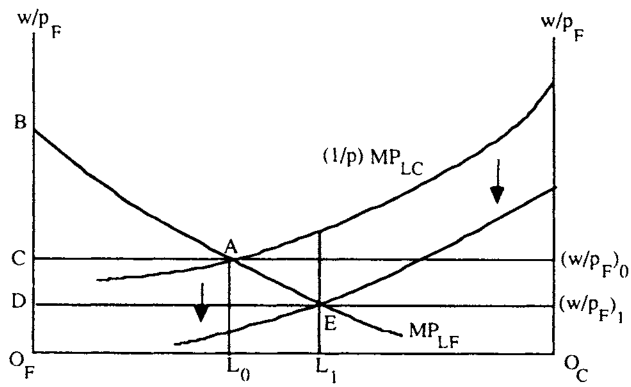

Figure 1.8b

is locked into its own sector, r_F and r_C are not, in general, equal. As in the Stolper–Samuelson case, we are interested in finding the effects of a rise in the relative price of food (due, for example, to a tariff on food) on the real returns to both factors.

The two diagrams in Figure 1.8 illustrate the determination of these real factor returns expressed in units of cloth and food, respectively. The mobile factor, labour, is measured along the horizontal axis, L_F being measured to the right of origin O_F and L_C to the left of O_C. The length of the axis, O_FO_C, is the economy's total labour supply L. In Figure 1.8a, both vertical axes measure variables in units of cloth (e.g. w/p_C). The two curves in the diagram represent the *value of the marginal product of labour*, measured in units of cloth, in the food and cloth sectors, respectively. These can be written as

$$\frac{\mathrm{VMP_{LF}}}{p_\mathrm{C}} = \left(\frac{p_\mathrm{F}}{p_\mathrm{C}}\right)\mathrm{MP_{LF}} = p\mathrm{MP_{LF}}$$

$$\frac{\mathrm{VMP_{LC}}}{p_\mathrm{C}} = \left(\frac{p_\mathrm{C}}{p_\mathrm{C}}\right)\mathrm{MP_{LC}} = \mathrm{MP_{LC}}.$$

where $p \equiv p_\mathrm{F}/p_\mathrm{C}$ is the relative price of food. Both curves slope downwards relative to their respective axes, reflecting the fact that the marginal product of labour in a sector declines as more labour is applied to a fixed quantity of the sector's specific factor.

As noted, labour is allocated between the two sectors to the point at which the value of its marginal product is the same in both sectors. Thus, in Figure 1.8a, the equilibrium labour allocation and the real wage w/p_C which clears the labour market are determined by the intersection of the curves $p\mathrm{MP_{LF}}$ and $\mathrm{MP_{LC}}$ at point B. The initial equilibrium wage measured in cloth units is $(w/p_\mathrm{C})_0$. Now suppose there is an increase in p, the relative price of food. This shifts $p\mathrm{MP_{LF}}$ up and to the right while $\mathrm{MP_{LC}}$ is unaffected. In Figure 1.8a, the equilibrium shifts from B to G.

Figure 1.8b is the same as Figure 1.8a except that the vertical axes measure variables in units of food (e.g. w/p_F). In this case, the curves represent

$$\frac{\mathrm{VMP_{LF}}}{p_\mathrm{F}} = \mathrm{MP_{LF}} \quad \text{and} \quad \frac{\mathrm{VMP_{LC}}}{p_\mathrm{F}} = \left(\frac{p_\mathrm{C}}{p_\mathrm{F}}\right)\mathrm{MP_{LC}} = \left(\frac{1}{p}\right)\mathrm{MP_{LC}}.$$

Initial equilibrium occurs where the two curves intersect at A. An increase in p shifts the cloth curve $(1/p)\mathrm{MP_{LC}}$ down but does not affect the food curve $\mathrm{MP_{LF}}$. Equilibrium moves from A to E.

What can we conclude about movements in real factor returns? From Figure 1.8a, we see that w/p_C goes up from $(w/p_\mathrm{C})_0$ to $(w/p_\mathrm{C})_1$ whereas Figure 1.8b tells us that w/p_F falls from $(w/p_\mathrm{F})_0$ to $(w/p_\mathrm{F})_1$. In other words, the nominal wage goes up but proportionately less than the price of food. What happens to a worker's real wage depends on the proportions in which she consumes the two goods. If we suppose that "food" is a small part of the consumer's budget, "cloth" being a "composite" of all other goods, then it seems reasonable to suppose that the real wage rises and that workers in both sectors stand to gain from a tariff on food.

In analysing the movements of the real returns to the specific factors, we are assisted by the fact that the quantities of K_F and K_C are fixed. Hence the direction of change in the aggregate return to the specific factor indicates the direction of change of the return per unit of the factor. In addition, the assumption of constant returns to scale implies that total factor rewards in each sector just exhaust the value of output. The value of output in a sector is just the area under the relevant VMP curve up to the labour employed in the sector. Subtract-